

PCT 34 AMDT

CLAIMS

1. A method for digestion of sludge in water purification, characterised by the steps:

5 a) providing at least one enzyme mixture capable of digesting natural polymeric materials;

b) adding the at least one enzyme mixture sequentially to an aqueous sludge suspension; and thereafter,

10 c) optionally adding at least one species of fermenting bacteria to the suspension, thereby fermenting the resulting suspension obtained in step b),

wherein enzymes in the at least one enzyme mixture are chosen from cellulases, cellobiases, amylases, lipases, pectinases, dextranases, oxidoreductases, proteases, pulpzymes and oxidases,

and the natural polymeric materials are proteins, polysaccharides, polyphenols (lignins), fats, waxes, and mineral oils.

20 2. A method according to claim 1, wherein at least one species of fermenting bacteria is added to the suspension in step c), thereby fermenting the resulting suspension obtained in step b).

3. A method according to claim 1 or 2, characterised by that the enzymes in a first enzyme mixture are chosen from cellulases, cellobiases, amylases, lipases, pectinases, dextranases, oxidoreductases, pulpzymes and oxidases, and the enzymes in a second enzyme mixture are chosen from cellulases, cellobiases, amylases, lipases, pectinases, dextranases, oxidoreductases, proteases, pulpzymes and oxidases.

4. A method according to any one of claims 1-3, characterised by that the enzyme mixture(s) comprise(s) a surfactant.

35 5. A method according to claim 4, characterised by that the surfactant is non-ionic.

6. A method according to claim 5, c h a r a c t e-
r i s e d by that the surfactant is chosen from natural
and synthetic alcohol ethoxylates, FAE (fatty alcohol
ethoxylate), non-ionic surface active agents prepared by
5 the addition of ethylene oxide to propylene glycols,
polydimethylsiloxane co-polymers and polyoxyethylene
derivatives of fatty acid partial esters of hexitol
anhydrides.

7. A method according to claim 6, c h a r a c t e-
10 r i s e d by that the surfactant is present in the range
of 0.0025-5 w/w % of the sludge suspension, in
particularly in the range of 0.0025-2 w/w %.

8. A method according to any one of claims 1-7,
c h a r a c t e r i s e d by that the dose of the enzyme
15 mixture in relation to sludge suspension is 0.2-0.001%
enzyme per 1% TS sludge.

9. A method according to 8, c h a r a c t e-
r i s e d by that the dose is 0.06-0.001% enzyme per 1%
TS sludge.

20 10. A method according to any one of claims 1-9,
c h a r a c t e r i s e d by that the fermenting bacteria
are chosen from acidogenic bacteria, acetogenic bacteria,
and methane producing bacteria.

11. A method according to claim 10, c h a r a c-
25 t e r i s e d by that the fermenting bacteria are chosen
from Gluconobacter oxydans, Acetobacter species,
Acetogenium kivui, Bacillus macerans, polymyxa, Bacillus
coagulans, Lactobacillus buchneri, Clostridium
thermoaceticus, Clostridium lentocellum, Clostridium
30 formicoaceticu, Clostridium thermocellum and Pseudomonas
species.

12. A method according to claim 11, c h a r a c t e-
r i s e d by that at least one of the species of the
fermenting bacteria is methane producing bacteria.

35 13. A method according to claim 12, c h a r a c t e-
r i s e d by that the methane producing bacteria are
chosen from Methanosarcina barkeri, Methanosarcina

mazeii, Methanosarcina soehngenii and Methanosarcina acetivorans; and Methanosaeta, and mixtures thereof.

14. A method according to claim 13, c h a r a c t e -
r i s e d by that the methane produced is separated from
5 the sludge suspension.

15. A method according to any one of claims 1-14, characterised by that the temperature of the sludge suspension is from 20°C to 90°C.

16. A method according to any one of claims 1-15,
10 c h a r a c t e r i s e d by that the sludge suspension
is subjected to agitation in the range from 0 to 180 rpm.

17. A method according to any one of claims 1-16,
c h a r a c t e r i s e d by that the sludge is pre-
concentrated, prior to the addition of enzymes and
15 bacteria, by gravitation or enhanced sedimentation to the
range 10-300 g sludge solids per 1 l sludge suspension.

18. A method according to any one of claims 1-17,
c h a r a c t e r i s e d by that the sludge suspension
is subjected to a pre-treatment chosen from the group
20 comprising acid treatment, base treatment, sonication,
grinding and heating.

19. Use of a method according to any one of claims 1-18, in addition to conventional digestion used in water purification.

25 20. Use of a method according to any one of claims
1-18, instead of conventional digestion used in water
purification.